Description

Method and apparatus for continuous metering

Field of the Invention

Background of the Invention

This invention relates to a method and an apparatus for continuous metering of bulk material from a container, with a rotary-vane feeder and a metering device following the rotary-vane feeder.

Such a system for continuous feed of bulk material is known from DE 40 23 948 A1, wherein a metering rotor scale according to DE 32 17 406 A1 or EP-A 0 198 956 is employed. This metering device following a bulk material feeder is connected downstream in a closed pneumatic conveyor path of a collecting device with a rotary-vane feeder. The bulk material mass contained therein can accordingly be determined continuously and influence either the speed of rotation of the rotary-vane feeder or the total air-flow amount of the feed blower, so that the bulk material throughput can be influenced by varying the amount of air supplied per unit time.

To effect the appropriate regulation of the desired mixing ratio or the desired feed amount per unit time (feed rate) a computer-controlled, central metering control system is employed, such as is described in DE 32 17 406 A1 for example, wherein a weigh signal of the bin scale cells of the collecting device serves as an input signal and the speed of rotation of the metering rotor and if desired of the rotary-vane feeder for the bulk material feed is regulated.

This regulating system is also described in more detail in EP-A 0 198 956 cited above, wherein the bulk material mass acting instantaneously in the metering rotor scale is detected, from which the bulk material mass throughput results through multiplication by the angular velocity of the metering rotor. The weighing electronics store the instantaneous bulk material mass present on the rotor weighing path (measuring path), so that the rotor angular velocity can be varied shortly before the discharge of the bulk material into the pneumatic conveyor line, in accordance with the predetermined set-point feed rate. A relatively high metering accuracy results from this, which is very well suited to metering powdered bulk material, for example in coal dust metering for cement rotary kilns or for metering gypsum or additives in flue gas purification.

However it has to be recognised that, with certain conveyed materials, these bulk materials can tend to form bridges, depending on the degree of moisture, fluidisation, fineness, etc., so that random or strongly pulsating fluctuations in the mass flow can occur in the bulk material discharge. These short-term mass flow fluctuations can be partially compensated by increased feed pressure, in particular even with large conveyor paths. However a greater leakage airstream to the container then occurs, which can lead to disturbances in the bulk material feed and the feed rate. To some extent

so that the expense of construction is increased substantially.

Summary of the Invention

Accordingly the invention is based on the object of providing a method and an apparatus for continuous metering of bulk material with which an improved tightness and large conveying capacity are obtained in a simple way.

This object is met by a method according to the features of claim 1 and by an apparatus according to the features of claim 5.

By regulating the following metering device relative to the feed rate of the preceding rotary-vane feeder or vice versa, an improved self-sealing results from the partial return feed in the rotary-vane feeder, through the bulk material elevated in the returning cells, and accordingly a substantial reduction in the leakage gas flow into the metering system, so that a high metering or conveying capacity is achieved. This is especially important for coal dust metering with large feed lengths and feed pressures.

~~Preferred embodiments are the subject matter of the dependent claims.~~

Brief Description Of the Drawings

Two embodiments will be described and explained in more detail below with reference to the drawings, in which:

Fig. 1 is a longitudinal sectional view through an apparatus for continuous bulk material metering with two rotary-vane feeders; and

Fig. 2 shows a modified embodiment of the apparatus according to Fig. 1, wherein a metering rotor scale is used for the metering.

Detailed Description Of the Invention

An apparatus 1 for continuous metering is shown in Fig. 1, wherein the feed material to be metered in accordance with and adjustable set-point value, especially a pourable bulk material, is fed out of a silo or container 2 by means of a discharge device 3 in the form of a rotary-vane feeder 4. The feed material passes into the rotary-vane feeder 4 and then into an intermediate container 5. The rotary-vane feeder 4 is preferably formed as a sealed lock, which feeds bulk material out of the intermediate container 5 constantly filled with bulk material back up again and into the returning cells 7 here on the right back to the container 2, as is shown in dots. The rotary-vane feeder 4 is driven by an electric motor 6, which is connected to a metering controller 10 for adjustment of the speed of rotation. The speed of rotation of the star wheel of the rotary-vane feeder 4 required for the "excess feed" is always (with otherwise equal dimensions) slightly higher than the speed of rotation of the lower rotary-vane feeder, which serves as a metering device.

However, in order to determine the mass flow of the rotary-vane feeder 4 the speed of rotation can also be derived directly from the drive shaft or the power taken by the drive motor 6. The rotary-vane feeder 4 shown here with a horizontal axis has the advantage of a relatively high

feeders with vertical axes can also be used.

A metering device 8, again in the form of a rotary-vane feeder, is provided at the lower end of the intermediate container 5, this device being driven by a motor 8a with a regulated speed of rotation and a blow-out line 9 opening into it. It is essential that the measured value sensor of the rotary-vane feeder 4, i.e. a speed of rotation transducer or tacho-generator for example on the motor 6, is connected to the metering controller 10, which thus determines the instantaneous mass flow of the rotary-vane feeder 4 and relates it to the feed rate of the metering device 8, in order to adjust or vary its speed of rotation or angular velocity in accordance with the feed rate of the rotary-vane feeder 4, in the sense of an excess feed. Accordingly, if there is a deviation of the mass flow at the rotary-vane feeder 4, the angular velocity of the metering device 8 is reduced by the corresponding value or the speed of rotation of the rotary-vane feeder 4 is increased, in order to keep the fill height constant in the intermediate container 5.

It is of essential importance that the bulk material is skimmed off to the container 2 by the rotary-vane feeder 4 on account of the constant filling of the intermediate container 5, so that the at least partially filled, return feed cells 7 substantially increase the tightness against leakage gas flows. Thus, it can be computed by the metering controller 10 what feed rate or speed of rotation of the rotary-vane feeder 4 is necessary to maintain the filling height and thus the return feed of about 30% of the bulk material. Depending on the angular velocity of the metering device 8 which is also measured (e.g. a tacho-generator on the motor 8a) the appropriate feed rate of the rotary-vane feeder 4 arranged above the metering device 8 can adjusted or regulated, taking into account the filling height below the rotary-vane feeder 4. The metering controller 10 can thus regulate the speed of rotation of the rotary-vane feeder 4 at all times taking into account the discharge rate of the metering device 8, so that a continuous, deliberate return feed to the container 2 is possible through the upwardly running, return feed cells 7 here on the right, and with this an improved tightness of the rotary-vane feeder 4 against leakage gas losses.

A modified embodiment of the apparatus 1 according to Fig. 1 is shown in Fig. 2, wherein a metering rotor scale 8' (especially according to the state of the art recited in the introduction), with a blow-out line 9 and a weighing cell 11, is arranged below the rotary-vane feeder 4 as a metering device 8. It should be noted that a horizontal lock (with a vertical axis) similar to the metering rotor 8' in Fig. 2 can be used instead of the lower rotary-vane feeder shown in Fig. 1. In an advantageous design, in order to keep the filling height constant below the rotary-vane feeder 4 its mass flow can be controlled or regulated to about 120 - 130% of the metering device 8, so that a return feed proportion of 20 - 30% into the rotary-vane feeder 4 occurs. In a particularly simple design it is

in order to achieve synchronous regulation of the upper and lower rotary-vane feeders or the metering rotor. Naturally separate motors 6 and 8a can equally be provided and be controlled in electronically coupled manner by the metering controller 10.

In the modified embodiment of the apparatus 1 for continuous gravimetric metering according to Fig. 2, a feed blower for the blow-out line 9 is also provided as a metering device 8 for the metering and further feed, with a construction otherwise similar to Fig. 1. The drive motor of the feed blower (not shown) can also be connected to the metering controller 10, so that the feed rate can be varied, in that the speed of rotation of the feed blower is increased or reduced briefly for example.

Because of the deliberate "backing up" of the bulk material in the constantly filled intermediate container 5, which can also be substantially smaller, in the nature of a compensator or bladder, bulk material is deliberately skimmed off by the rotary-vane feeder 4 and constantly fed back, so that this bulk material serves for self-sealing of the rotary-vane feeder 4 against leakage gas losses.